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(54) FIBROUS CELLULOSIC MATERIAL

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No. OF CLAIMS 17

This invention relates to products which in one way or another are temporarily impervious to water, but which nevertheless can be broken up or disintegrated in water, and to a method for producing such products.

The invention has its origin primarily in the desire to solve certain problems of sanitary character. In hospitals, for example, it is desired to have some sort of insert in basins or chamber-vessels in order to avoid or to facilitate the unpleasant and awkward work of cleaning such containers, and for preventing the spread of infectious matter. The insert must withstand the contents for some period, but shall after its dumping into the soil pipe disintegrate within a short time and be taken along by the flush water. Examples of other products desired not to soak immediately but first after a certain time, so that they can be flushed without risk into ordinary waste pipes, are diapers, sanitary towels, face napkins, paper towels, toilet paper and the like.

The present invention has solved these problems in a simple and surprisingly effective way in that materials adapted to dissolve and break up respectively in water are combined in two or more layers. The combination comprises at least one layer dissolving in water, preferably a polymer foil, and at least one layer disintegrating (breaking up) in water, preferably of paper.

A product according to the invention in its most simple embodiment comprises an upper water-soluble polymer foil and a lower paper breaking up in water. When pouring water in limited quantities on the upper surface of the combination material, the water-soluble polymer film swells and gradually dissolves. This takes, however, a long time if no special stirring is effected. By using a suitable polymer the swollen, possibly partially dissolved polymer film becomes viscous to such a high degree that for a period of substantial length the water cannot soak the underlying paper. By immersing the entire product into an ample amount of water the paper and the foil are completely and rapidly soaked. In such a case, only a slight stirring is needed to effect complete disintegration of the product, so that it can be flushed without risk through the pipes.

The aforedescribed simple embodiment of the invention may, for example, be used as insert in basins. When the same idea shall be applied to the production of a diaper or sanitary towel, a combination of three layers is to be preferred. The layer closest to the body must be absorbent and, for example, be made of cellulose. On the outside thereof is placed a water-soluble polymer film serving as a temporary liquid barrier. The outermost layer is a further cellulose layer or the like. When water penetrates into the first cellulose layer, the polymer film prevents it temporarily from soaking also the second cellulose layer. When the diaper or sanitary towel is flushed into the waste pipe, water penetrates into both of said cellulose layers to such amounts that the said layers rapidly disintegrate at the same time as the polymer film is dissolved in a short time. Also in the case of toilet paper, a three-layer combination can be used.

As water-soluble polymer may be chosen, for example, natural products such as materials of the protein or carbohydrate type. As examples of such material can be mentioned gelatin, casein, vegetable rubber of various types, starch and alginate. Also semi-synthetic substances such as derivatives of the aforesaid natural products may be used. Particularly adapted are water-soluble cellulose derivatives such as methylcellulose, hydroxy ethylcellulose, ethylhydroxy ethylcellulose and carboxymethyl cellulose, the latter in the form of a salt. Furthermore, a plurality of all-synthetic polymers are adapted, for example polyvinyl alcohol, polyethylene oxide and polyvinyl pyrrolidone.

For being adapted to be used in connection with the present invention the polymer must not only be water-soluble but also molecular to a sufficiently high degree in order to render high viscosity in aqueous solution, because otherwise there would be a great risk of rapid soaking. Practical experiments with two-layer combinations have shown that the polymer in a 2% aqueous solution must have a viscosity of at least 100 centipoise at 20°C determined with Brockfield viscosimeter at 50 r.p.m. In three-layer combinations the polymer may be lower molecular. The polymer film according to the invention must be of such a material that it swells and dissolves or disintegrates in another way within a short time, for example 3 hours, preferably

within a period shorter than 1 hour after it was immersed entirely in water.

With the help of a special technique, however, also foils of low molecular polymers may be used for the object according to the invention. Such a technique comprises the step of treating the fibrous support with a gelling agent for the polymer before the polymer foil is applied to the support. As examples of polymers and associated suitable gelling agents may be mentioned polyvinyl alcohol borax, sodium carboxymethylcellulose-aluminum ions and sodium alginate-calcium ions. Upon supplying water to the polymer foil, the foil dissolves to a solution of low viscosity which rapidly would soak the support if this would not have been treated with a gelling agent. When, however, the support contains such gelling agent for the polymer, the solution coagulates to a gel and the water is prevented from continuing to penetrate into the support. The gelling agent may be applied to the support in different ways, for example by spraying it on the support whereafter the gelling agent is allowed to dry before the polymer foil is attached. It is obvious that by suitably choosing and proportioning the gelling agent and polymer a temporarily water impervious material having the properties suitable for every individual purpose can be obtained.

The water-soluble polymer film may be produced in different ways. In principle, one may distinguish two methods, viz. spinning the solution through a slot or melting, pouring and drying the solution on a support.

The thickness of the film has a lower limit in view of the strength and of the difficulties in making a thin film without holes, and an upper limit for economical reasons. A practically suitable substance range is 25 to 200 g/m^2. The higher the viscosity degree of the polymer used, the thinner the film can be made without making its effectiveness to suffer therefrom.

The majority of the polymers listed above result in relatively brittle films, particularly in dry air. In such cases preferably a softener is added, for example glycerol or different glycols. Also certain salts, for example magnesuim chloride, have in many cases a plasticizing effect. A salt addition, moreover, may also contribute to a more rapid dissolution of the polymer foil in water, if such is desired. For reasons of strength it may

also be advantageous to reinforce the foil by fibers. The amount of softening or reinforcing agent to be added may be of the magnitude 0,1 to 1 part by weight per part by weight of polymer.

The layer adapted to be broken up or disintegrated in water and being comprised in products according to the invention may be of a porous material. For this reason, it is generally built up of small elements connected relative one another by forces which are weakened or destroyed in water. Examples of such materials are above all different types of products formed of fibers or, in other words, paper, non-woven textiles and like materials. Particularly adapted for the invention are unsized or slightly sized paper, for example cellulose, filter paper or the like. It is not necessary that the paper is made of bleached cellulose, even if such is preferred for esthetic reasons.

In view of the fact that a product according to the invention must be adapted to be flushed after its use directly into an ordinary waste pipe, the layer disintegrating in water or in another liquid must show low wet strength values. It was found that the wet strength must be below about 500 g breaking load determined on a completely wet material strip of 4 cm width within 1 minute after it was soaked. The wet strength must preferably be below about 100 g. Wet strength values of about 20 g and below determined on paper with an air-dry substance of about 20 to 30 g/m^2 have proved to render the best results, especially because then the risk of clogging the wast pipes is entirely eliminated even under otherwise unfavorable conditions.

The aforementioned wet strength refers to the individual fibre layer which preferably consists of a cellulose or paper material. Corresponding values, however, apply substantially also to the combination according to the invention comprising one or several of such fibrous layers and a polymer layer adapted to dissolve in water or in another liquid when the combination material is soaked from both sides, because the polymer layer thereof dissolves or becomes such weak that it does not contribute appreciably to the wet strength of the combination material.

The thickness of the paper layer depends on the way the product

according to the invention is supposed to be used. In its simpliest embodiment a relatively thin paper is sufficient, for example a paper having a substance of 25 to 100 g/m^2. In the aforedescribed three-layer combination for diapers and the like, at least the inner layer must be given a greater thickness, for example 100 to 1000 g/m^2.

The assembly of the different layers to form a product according to the invention may easily be made by placing the layers upon one another. In many cases, the layers need not be anchored one to another. When such anchoring is required, this is easily obtained, for example by cold or hot moulding press or glueing. In principle, it is possible to form a product according to the invention by coating the paper with a polymer solution which thereafter is dried to form a film. In practice, this method has proved less suitable because the solution somewhat penetrates into the paper. As a result thereof, the film is not entirely coherent and dense, and the capacity of the paper to disintegrate in water is deteriorated.

The invention will be described in a greater detail in the following, reference being had to the accompanying drawing and the examples given below.

Referring to the drawing,Figure 1 shows a cross-section of a molding tool for the manufacture of a product according to an embodiment of the invention, and a material inserted in the mold,

Figure 2 shows in cross-section a piece of a material according to another embodiment.

Example 1

A commercially available water-soluble cellulose derivative having the quality description Cellufix 3000 was chosen for the preparation of the polymer foil. The product contains about 85% of a sodium salt of carboxy methylcellulose. The remainder is substantially water and common salt. Two parts by weight of this product were solved in 98 parts by weight of water, resulting in a viscosity of the solution of 3000 cP. After the addition of two parts by weight of glycerol the solution was spread on a glass pane with the help of a doctor, so that a liquid film of about 2 mm thickness was ob-

tained. The film was dried by hot air whereafter a strong and tough foil could be drawn off the glass pane. The foil had a substance of about 80 g/m^2.

The foil was placed on a cellulose layer having the substance 60 g/m^2. Both said layers were thereafter laid into a mold, as appears from Figure 1 which shows a cross-section of the mold comprising a plunger 1 and a cavity 2. The mold was used for producing circular bowls of a starting material comprising the cellulose layer 3 and the polymer layer 4 attached thereon.

A bowl produced according to the aforedescribed method was placed as an insert within a similar bowl of stainless steel. In to said bowl water was poured, and the bowl was left alone for some time, during which time observations were made with respect to a possible soaking of the insert. After 6 hours the cellulose layer was still dry on its lower surface. The insert was dumped into a water-closet. After a very short time the insert was soaked and could be flushed away without difficulties.

Example 2

A diaper was prepared of a material, a piece of which is shown in Figure 2. Said material comprises three layers 5, 6 and 7 whereof the two outer layers 5 and 7 were made of 10 cellulose sheet layers of a commerically available type. Each of the cellulose layers had a substance of about 30 g/m^2. The central layer 6 was a foil of a cellulose derivative of high viscosity which upon its solution in water rendered a viscosity of 1000 cP in 2% solution. The foil had a substance of 40 g/m^2. For comparison, a diaper was prepared having no central foil, i.e. the iaper comprised only 20 cellulose sheets.

The diapers were tested by pouring about 1 dl colored water on their upper surface. The water penetrated rapidly through the unprepared diaper, but the prepared diaper remained dry on its lower surface for several hours. Both diapers could be flushed in the water-closet, which flushing was made with small diaper portions at a time in view of the great cellulose amount and the risk of clogging the water system pipes. It was proved by tests, however, that the diaper immersed in water gradually was disintegrated and distributed in the water within about 3 hours. Already before its complete

disintegration, however, the material was softened and broken up to such a degree that the risk of clogging the waste pipes could be deemed eliminated.

The invention is not restricted to the embodiments shown and described, because further applications and modifications can be imagined within its scope. As examples may be mentioned throw-away cleaning towels, packing material for special purposes etc. Containers for temporarily receiving urine and evacuation, so-called urin containers and colostomy bags may also be manufactured with advantage of a product according to the invention, rendering it possible to flush these containers after their use inclusive of their contents directly into the waste line.

THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. A product for sanitary and hygienic purposes having the property of readily disintegrating in water after soaking said product comprising at least one layer of fibrous cellulosic material, the wet strength of which being not greater than 100 g breaking load determined on a completely wet material strip of 4 cm width within one minute after soaking and further comprising a water-barrier having a basis weight of 25-200 g/m^2 and consisting of at least one layer of a water soluble polymer having a viscosity of at least 100 centipoise in a 2% aqueous solution of 20°C, said water barrier having the property of preventing substantial passage of water from one side to the opposite side thereof for at least 6 hours after exposing only one side of the product to water but dissolving within 3 hours after exposing both sides of said product to water.

2. A product according to claim 1, wherein the wet strength of the fibrous cellulosic material corresponds to a breaking load below 20 g determined on a completely wet material strip having an air-dry substance of 20-30 g/m^2 and a width of 4 cm within 1 minute after soaking said strip.

3. A product according to claims 1 or 2 wherein the fibrous cellulosic material is a substantially unsized paper.

4. A product according to claims 1 or 2 wherein the water soluble polymer is a cellulose derivative.

5. A product according to claims 1 or 2 wherein the water soluble polymer is carboxymethyl cellulose.

6. A product according to claims 1 or 2 wherein the water soluble polymer is an all-synthetic polymer.

7. A product according to claims 1 or 2 wherein the water soluble polymer is polyethylene oxide.

8. A product according to claim 1 wherein the fibrous cellulosic material is coated with or contains a gelling agent for the polymer in the polymer layer.

9. A product according to claim 8 wherein the polymer is polyvinyl alcohol and the gelling agent is borax.

10. A product according to claim 8 wherein the polymer is sodium carboxymethylcellulose and the gelling agent is a substance capable of giving off aluminum ions.

11. A product according to claim 8 wherein the polymer is sodium alginate and the gelling agent is a substance capable of giving off calcium ions.

12. Bed pan insert consisting of a product according to claims 1, 2 or 8 with the fibrous cellulosic material consisting of a substantially unsized paper and the water soluble polymer consisting of a cellulose derivative.

13. Bed pan insert consisting of a product according to claims 1, 2 or 8 with the fibrous cellulosic material consisting of a substantially unsized paper and the water soluble polymer consisting of carboxymethyl cellulose.

14. Napkin consisting of a product according to claims 1, 2 or 8 comprising a layer of a water soluble polymer provided between two or more layers of fibrous cellulosic material.

15. Sanitary towel consisting of a product according to claims 1, 2 or 8 comprising a layer of water soluble polymer provided between two or more layers of fibrous cellulosic material.

16. Toilet paper manufactured of a product according to claims 1, 2 or 8 comprising a layer of water soluble polymer provided between two or more layers of fibrous cellulosic material.

17. A device for temporarily receiving urine or evacuation, consisting of a product according to claims 1, 2 or 8.

FIG.1

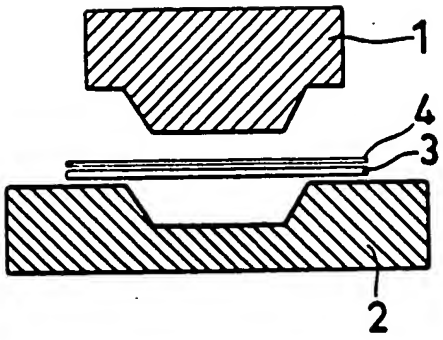

FIG.2